

of whole gale force which died down as the anticyclone was disintegrated on passing off unto the Gulf Stream. On the morning of the 21st this storm had on its periphery the small vortex of the hurricane marked "V" on the chart, the latter apparently continuing as a separate disturbance. Lacking reports over that portion of the Atlantic, the further history of this interesting pair is not now known.

Cyclones.	Al- berta.	North Pa- cific.	South Pa- cific.	North- ern Rocky Moun- tain.	Colo- rado.	Texas.	East Gulf.	South At- lantic.	Cent- ral.	Total.
September, 1922.	5.0			1.0			1.0	1.0	2.0	10.0
Average number, 1892-1912, in- clusive.....	4.1	1.1	0.4	0.6	0.7	0.3	0.4	0.2	0.7	8.5

Anticyclones.	North Pacific.	South Pacific.	Alber- ta.	Plateau and Rocky Moun- tain Region.	Hudson Bay.	Total.
September, 1922.			2.0		2.0	8.0
Average number, 1892-1912, in- clusive.....	2.1	1.0	3.5	0.7	0.6	7.9

FREE-AIR CONDITIONS.

By L. T. SAMUELS, Meteorologist.

Free-air temperatures were, in general, above the average for the month. (See Table 1.) Departures at the surface and lower levels conformed closely with those shown in Climatological Chart III. Exceptions in this respect may be explained as follows: The negative departures found at the surface and 250-meter level at Broken Arrow are very likely a result of the large percentage of kite flights made during the early morning and evening hours, at which times wind conditions were most favorable. The small negative departures found at Due West at all levels would seem to be due to the very short period from which present averages are now obtainable. During the first part of the month, when abnormally high temperatures prevailed generally over the country east of the Rocky Mountains, every aerological station reported maximum temperatures exceeding its previous records for September. These occurred in most cases both at the surface and at various levels above. An examination of the prevailing wind direction at these times revealed a southerly component in every case, thus giving additional evidence of the close relation between free-air temperatures and the source of the air supply.

Relative humidities were mostly below the average for both upper and lower levels, but departures were small in practically all cases.

Vapor pressure departures were in general agreement with those for temperature. During the latter part of the month when drouth conditions were prevalent over large sections of the Plains States and the region east of the Mississippi River, it was noted that vapor pressures at the surface and in the upper levels remained appre-

ciably below their averages. These departures were especially large at the southern stations and very likely account for the large negative departures found at Broken Arrow and Groesbeck in Table 1.

In Table 2 are shown the resultant winds for the month and their averages. The larger southerly components for the month compared to the average are in striking agreement with the positive temperature departures previously referred to.

Pilot-balloon observations at Washington and surrounding stations on the 26th showed complete reversals of the wind direction above the 1,500 meter level from those at the surface. This region was in the southern part of an anticyclone and easterly surface winds shifted to westerly at comparatively low altitudes. As is usually found under such conditions the surface-temperature gradients from south to north were steep, and thereby were instrumental in reversing the surface-pressure system a short distance above.

A significant feature of the month was the westerly winds observed in the lower and upper levels at San Juan on the 17th and 18th, a direction exactly opposite to that usually found in this latitude. In the discussion of "Storms and weather warnings" during the month by E. H. Bowie in this number of the REVIEW, reference is made to the disturbance suddenly appearing off the east Florida coast on the morning of the 18th. The abnormal westerly winds observed in the lower and upper levels at San Juan on the previous day seem to have been intimately connected with the disturbance shown by later surface observations to have been in the vicinity of the Florida coast. The winds at Santo Domingo, Dominican Republic, likewise had a westerly component in the lower levels on the 17th and in the upper levels on the 18th.

The following stations reported pilot-balloon observations showing wind velocities of 30 m. p. s. or higher.

Station.	Septem- ber.	Velocity.	Direction.	Altitude.
		m. p. s.		m.
Ellendale, N. Dak.....	8	33	WSW.....	4,400
Do.....	15	33	WNW.....	7,400
Do.....	26	40	WNW.....	28,200
Lansing, Mich.....	29	30	NNE.....	15,000
Do.....	26	30	N.....	11,200
Lee Hall, Va.....	16	31	W.....	9,780

The observation at Ellendale on the 26th, referred to above, was made with a single theodolite and, as such, must be taken with reservation at such a great altitude.

Easterly movement of the atmosphere above 10,000 meters was observed by means of pilot balloons at the following stations.

Station.	September.	Station.	September.
Aberdeen, Md.....	15	Key West, Fla.....	2, 5, 12
Bolling Field, D. C.....	17, 18	Camp Knox, Ky.....	6
Camp Bragg, N. C.....	22	Lansing, Mich.....	20, 27, 28, 29
Broken Arrow, Okla.....	4, 15, 22	Madison, Wis.....	26, 27, 28
Drexel, Nebr.....	26	Royal Center, Ind.....	21, 22, 26, 29
Ellendale, N. Dak.....	19	San Juan, P. R.....	30
Groesbeck, Tex.....	1	Washington, D. C.....	28
Ithaca, N. Y.....	30		

A number of single-theodolite pilot-balloon observations exceeding 15,000 meters in altitude were made during the month but, since double-theodolite observations above this altitude are as yet unavailable, the reliability of these results must remain, to a large extent, uncertain.

TABLE 1.—Free-air temperatures, relative humidities, and vapor pressures during September, 1922.

TEMPERATURE (°C.).												
Altitude, M. S. L. (m.)	Broken Arrow, Okla. (233m.)		Drexel, Nebr. (396m.)		Due West, S. C. (217m.)		Ellendale, N. Dak. (444m.)		Groesbeck, Tex. (141m.)		Royal Center, Ind. (225m.)	
	Mean.	De- parture from aver- age.	Mean.	De- parture from aver- age.	Mean.	De- parture from aver- age.	Mean.	De- parture from aver- age.	Mean.	De- parture from aver- age.	Mean.	De- parture from aver- age.
Surface..	22.9	-1.0	20.3	+1.5	24.3	-0.4	15.2	+0.4	25.1	+0.3	24.2	+1.9
250.....	22.8	-0.9	20.3	+1.5	23.9	-0.4	15.2	.....	24.8	+0.7	24.0	+1.9
500.....	22.3	+0.3	19.6	+1.2	21.1	-0.7	15.7	+0.9	23.9	+1.4	21.7	+1.0
750.....	21.2	+0.6	18.9	+1.6	19.3	-0.8	16.7	+2.4	22.5	+1.5	19.8	+1.7
1,000.....	19.7	+0.5	18.4	+2.1	18.1	-0.7	16.3	+3.0	21.1	+1.3	18.2	+1.6
1,250.....	18.3	+0.5	17.4	+2.2	17.0	-0.5	15.4	+3.1	19.5	+1.0	16.6	+1.5
1,500.....	17.0	+0.6	16.1	+2.1	15.7	-0.4	14.4	+3.2	17.9	+0.6	14.7	+1.2
2,000.....	14.4	+0.6	13.3	+2.0	13.0	-0.3	11.9	+3.2	14.9	0.0	12.3	+1.5
2,500.....	11.2	+0.4	9.9	+1.8	9.9	-0.3	8.8	+3.1	12.2	-0.1	9.5	+1.3
3,000.....	8.0	+0.2	6.4	+1.5	6.6	-0.3	6.1	+3.4	9.7	0.0	6.6	+0.9
3,500.....	4.6	+0.1	2.9	+1.0	3.3	-0.3	3.5	+3.5	6.5	-0.6	3.8	+0.8
4,000.....	1.6	+0.2	-0.2	+0.8	-0.1	-0.3	1.8	+4.3	3.1	-1.2	0.8	+0.5
4,500.....	-1.9	+0.1	-3.6	+0.5	-4.6	-0.3	0.2	+5.1	.....	.....	.....	.....
5,000.....	.....	.....	-5.4	+1.3	.....	.....	-1.9	+5.6	.....	.....	.....	.....

TABLE 1.—Free-air temperatures, relative humidities, and vapor pressures during September, 1922—Continued.

RELATIVE HUMIDITY (%).												
Altitude. M. S. L. (m.)	Broken Arrow, Okla. (233m.)		Drexel, Nebr. (396m.)		Due West, S. C. (217m.)		Ellendale, N. Dak. (444m.)		Groesbeck, Tex. (141m.)		Royal Center, Ind. (225m.)	
	Mean.	De- parture from average.	Mean.	De- parture from average.	Mean.	De- parture from average.	Mean.	De- parture from average.	Mean.	De- parture from average.	Mean.	De- parture from average.
Surface...	62	-4	60	-4	59	-3	69	+4	69	-8	56	-7
250.....	62	-4	60	-2	60	-2	69	+4	69	-8	56	-7
500.....	58	-7	60	-2	67	+1	66	+2	68	-9	57	-7
750.....	57	-7	54	-5	69	+2	58	-3	68	-7	59	-5
1,000.....	57	-6	51	-6	67	+1	54	-5	69	-4	60	-3
1,250.....	56	-7	51	-4	65	+1	51	-5	71	0	62	0
1,500.....	54	-7	52	-1	62	0	49	-5	72	+4	62	+1
2,000.....	53	-4	51	0	57	-1	44	-6	70	+9	59	+1
2,500.....	51	+2	55	+3	56	-1	43	-6	61	+5	56	+1
3,000.....	53	+4	59	+6	51	-1	44	-5	51	-3	56	+4
3,500.....	55	+3	59	+8	47	-1	46	-1	42	-9	59	+8
4,000.....	52	0	56	+6	47	-1	43	-2	50	+3	66	+1.5
4,500.....	67	+7	58	+5	49	-1	41	-2	.....	.....	.....	.....
4,000.....	.....	.....	52	+1	.....	.....	40	-1	.....	.....	.....	.....

VAPOR PRESSURE (mb.).												
Surface...	17.16	-2.69	14.09	-0.02	17.75	-1.43	11.84	+0.00	21.84	-2.05	17.02	+0.27
250.....	17.09	-2.64	14.09	-0.02	17.59	-1.36	11.84	+0.00	21.48	-1.61	16.84	+0.29
500.....	15.82	-1.87	13.37	-0.13	16.46	-1.00	10.66	+0.89	20.10	-0.91	15.14	+0.37
750.....	14.59	-1.38	11.89	-0.21	15.18	-0.94	10.68	+0.81	18.63	-0.35	14.06	+0.72
1,000.....	13.37	-1.06	10.95	-0.04	13.87	-0.74	9.57	+0.64	17.10	+0.24	13.14	+0.99
1,250.....	12.16	-0.86	10.25	+0.34	12.60	-0.52	8.61	+0.65	16.15	+0.97	12.24	+1.29
1,500.....	10.82	-0.68	9.51	+0.64	11.30	-0.48	7.68	+0.53	14.87	+1.38	11.07	+1.52
2,000.....	8.85	+0.03	7.96	+0.80	9.23	-0.41	6.15	+0.35	12.11	+1.71	9.22	+1.86
2,500.....	7.17	+0.87	6.50	+0.93	7.89	-0.29	4.89	-0.03	9.04	+0.95	7.19	+1.44
3,000.....	5.52	+1.07	5.74	+0.89	6.87	-0.29	4.31	+0.10	6.43	-0.15	5.93	+1.67
3,500.....	4.41	+0.83	4.64	+0.76	5.81	-0.29	3.88	+0.28	4.23	-0.99	5.52	+2.16
4,000.....	3.07	+0.47	3.31	+0.43	4.31	-0.29	3.35	+0.28	3.53	-0.53	5.21	+2.37
4,500.....	2.92	+0.79	3.31	+0.55	4.85	-0.29	3.03	+0.27	.....	.....	.....	.....
5,000.....	.....	.....	2.91	+0.61	.....	.....	2.63	+0.39	.....	.....	.....	.....

VAPOR PRESSURE (mb.).

Surface...	17.16	-2.69	14.09	-0.02	17.75	-1.43	11.84	+0.00	21.84	-2.05	17.02	+0.27
250.....	17.09	-2.64	.....	.....	17.59	-1.36	.....	.....	21.48	-1.61	16.84	+0.29
500.....	15.82	-1.87	13.37	-0.13	16.46	-1.00	11.66	+0.89	20.10	-0.91	15.14	+0.37
750.....	14.59	-1.38	11.89	-0.21	15.18	-0.94	10.68	+0.81	18.68	-0.35	14.06	+0.72
1,000.....	13.37	-1.06	10.95	-0.04	13.57	-0.74	9.57	+0.64	17.10	+0.24	13.14	+0.99
1,250.....	12.16	-0.86	10.25	+0.34	12.60	-0.52	8.61	+0.65	16.15	+0.97	12.24	+1.29
1,500.....	10.82	-0.68	9.51	+0.64	11.30	-0.48	7.68	+0.53	14.87	+1.38	11.07	+1.32
2,000.....	8.85	+0.03	7.96	+0.80	9.23	-0.41	6.15	+0.35	12.11	+1.71	9.22	+1.55
2,500.....	7.17	+0.87	6.80	+0.93	7.89	-0.29	4.89	-0.03	9.04	+0.95	7.19	+1.44
3,000.....	5.52	+1.07	5.74	+0.89	6.87	-0.29	4.31	+0.10	6.43	-0.15	5.93	+1.57
3,500.....	4.41	+0.83	4.64	+0.75	5.81	-0.29	3.88	-0.28	4.23	-0.99	5.52	+2.16
4,000.....	3.07	+0.47	3.67	+0.43	5.31	-0.29	3.35	-0.28	3.53	-0.53	5.21	+2.37
4,500.....	2.92	+0.79	3.31	+0.55	4.85	-0.29	3.03	+0.27	.....	.....	.....	.....
5,000.....	.....	.....	2.91	+0.61	.....	.....	2.65	+0.39	.....	.....	.....	.....

TABLE 2.—Free-air resultant wind directions and velocities (m. p. s.) during September, 1922.

Altitude, m. s. l. (m.)	Broken Arrow, Okla. (233m.)				Drexel, Nebr. (396m.)				Due West, S. C. (217m.)				Ellendale, N. Dak. (444m.)				Groesbeck, Tex. (141m.)				Royal Center, Ind. (225m.)			
	Mean.		Average.		Mean.		Average.		Mean.		Average.		Mean.		Average.		Mean.		Average.		Mean.		Average.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface.....	S. 29° E.	2.1	S. 1° W.	3.6	S. 2° W.	2.7	S. 14° W.	2.0	N. 62° E.	3.2	N. 72° E.	2.1	S. 75° W.	0.9	N. 79° W.	1.0	N. 84° E.	1.6	S. 23° E.	1.7	S. 24° W.	1.2	S. 57° W.	1.5
250.....	S. 26° E.	2.1	S. 1° W.	3.7	.....	.....	.....	.....	N. 58° E.	2.8	N. 68° E.	1.8	.....	.....	.....	.....	S. 85° E.	2.4	S. 20° E.	2.4	S. 28° W.	1.5	S. 57° W.	1.8
500.....	S. 14° E.	2.9	S. 10° W.	5.1	S. 2° W.	3.7	S. 14° W.	2.6	N. 54° E.	3.6	N. 64° E.	2.1	S. 44° W.	0.9	.....	.....	S. 69° E.	3.1	S. 13° E.	4.0	S. 31° W.	3.4	S. 54° W.	3.2
750.....	S. 8° E.	3.2	S. 15° W.	5.8	.....	.....	.....	.....	S. 27° W.	3.8	N. 47° E.	3.6	N. 47° E.	1.9	S. 49° W.	2.4	S. 76° W.	1.5	S. 66° E.	4.5	S. 35° W.	4.2	S. 61° W.	4.1
1,000.....	S. 3° W.	2.8	S. 22° W.	5.6	S. 16° W.	4.8	S. 36° W.	4.1	N. 45° E.	3.8	N. 32° E.	1.9	S. 56° W.	3.5	S. 74° W.	2.5	S. 64° E.	3.9	S. 8° E.	4.7	S. 43° W.	4.6	S. 60° W.	4.9
1,250.....	S. 16° W.	2.5	S. 26° W.	5.5	S. 32° W.	5.0	S. 51° W.	4.4	N. 41° E.	4.4	N. 22° E.	2.4	S. 64° W.	4.1	S. 75° W.	3.1	S. 64° E.	4.0	S. 8° E.	4.8	S. 54° W.	5.2	S. 72° W.	5.9
1,500.....	S. 33° W.	2.4	S. 35° W.	5.5	S. 45° W.	5.2	S. 61° W.	5.0	N. 40° E.	5.1	N. 14° E.	2.9	S. 68° W.	4.7	S. 82° W.	4.0	S. 62° E.	4.8	S. 10° E.	4.7	S. 60° W.	5.9	S. 76° W.	6.6
2,000.....	S. 43° W.	2.5	S. 41° W.	6.4	S. 60° W.	5.1	S. 70° W.	6.0	N. 32° E.	4.5	N. 7° E.	2.8	S. 75° W.	6.2	S. 82° W.	5.5	S. 62° E.	4.2	S. 9° E.	4.5	S. 64° W.	8.3	S. 76° W.	8.7
2,500.....	S. 50° W.	2.4	S. 43° W.	5.5	S. 66° W.	5.6	S. 78° W.	7.6	N. 41° E.	6.1	N. 18° E.	3.0	S. 72° W.	7.0	S. 84° W.	7.4	S. 70° E.	4.9	S. 13° E.	4.4	S. 66° W.	11.8	S. 78° W.	10.3
3,000.....	S. 54° W.	3.1	S. 36° W.	6.3	S. 70° W.	7.7	S. 82° W.	9.3	N. 42° E.	6.7	N. 40° E.	3.9	S. 83° W.	9.7	S. 86° W.	9.5	S. 89° E.	5.1	S. 11° E.	4.3	S. 66° W.	14.7	S. 78° W.	12.7
3,500.....	S. 60° W.	3.4	S. 42° W.	5.4	S. 69° W.	10.1	N. 39° W.	10.5	N. 43° E.	7.0	N. 43° E.	7.0	S. 82° W.	12.6	S. 85° W.	10.9	N. 58° E.	5.9	S. 6° E.	3.9	N. 86° W.	14.0	S. 85° W.	12.7
4,000.....	S. 43° W.	5.1	S. 62° W.	6.7	S. 89° W.	11.3	N. 76° W.	12.5	N. 53° E.	9.0	N. 53° E.	9.0	.....	.....	.....	.....	N. 60° E.	4.6	S. 10° E.	4.6	N. 42° W.	19.9	N. 77° W.	10.9
4,500.....	S. 65° W.	5.8	S. 85° W.	7.4	N. 67° W.	15.9	N. 67° W.	14.8	N. 45° E.	13.1	N. 45° E.	13.1	N. 67° W.	16.7	N. 70° W.	15.8	.....	.....	.....	.....	.....	.....	.....	.....
5,000.....	.....	.....	.....	.....	N. 75° W.	16.7	N. 68° W.	16.3	N. 45° E.	13.8	N. 45° E.	13.8	N. 45° W.	14.4	N. 88° W.	13.7	.....	.....	.....	.....	.....	.....	.....	.....

THE WEATHER ELEMENTS.

By P. C. DAY, Meteorologist in Charge of Division.

PRESSURE AND WINDS.

During September the development of the continental high-pressure area over the United States, characteristic of the colder months of the year, signs of which are frequently observed in August, is usually well under way in nearly all parts of the country. The only exception to this is in the extreme southeastern part where the occa-

sional recurving of tropical storms tends to a further lowering of the average pressure as compared with August. In the Canadian Northwest, immediately east of the mountains there appears to be a slight temporary halt in the development of the winter-high area, and pressure there is slightly lower than in August. Indications of this are also noticed in the adjacent portions of the United States. To the westward of the mountains and over the eastern Provinces the average pressure for September increases over that for August, the excess becoming fairly large in the Maritime Provinces.